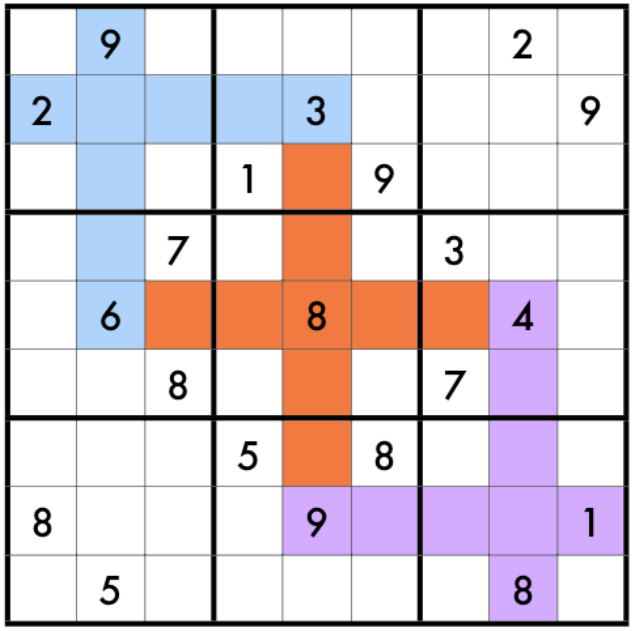
SUDOKU PLUS

Fill in the grid so that each row, each column, each 3x3 block, and each of the three "plus" regions contain the integers 1-9 exactly once.



2011 brainfreezepuzzles.com

Gummy Bear Contest!

At the puzzle table near the registration area is a container of gummy bears. Guess how many and you will win a prize!

Rules: Each person may enter only one time. Your guess must consist of a connected *interval* of real numbers. The winning entry will be the smallest interval containing the actual number of gummy bears, with any ties broken using the distance from the center of the interval to the actual number. The winner will be announced at the prize session at the end of the day.

Hints: This year there are no hints. HA HA HA HA HA.

Join us next October for SUMS 2012!
To be added to the SUMS mailing list, contact one of the conference organizers:
Dr. Elizabeth Brown (brownet@math.jmu.edu) or Dr. Laura Taalman (taal@math.jmu.edu)

SUMS 7

James Madison University

7th Shenandoah Undergraduate Mathematics and Statistics Conference

Saturday, October 22, 2011

All events are on the second floor of the JMU HHS Building

Support for the Shenandoah Undergraduate Mathematics and Statistics Conference is provided by:

National Science Foundation grant DMS-0846477, Mathematical Association of America, Regional Undergraduate Mathematics Conferences program

James Madison University Department of Mathematics and Statistics, College of Science and Mathematics, General Education Program, Office of the Special Assistant to the President for Diversity, Office of Admissions, Pi Mu Epsilon, and Mathematics and Statistics Club

Contributions of books, puzzles, games, and other prizes came from the following generous sponsors of SUMS:

Schedule

9:00-10:00 Registration and Breakfast *2nd floor hallway*

If you have not registered online, please visit the registration table in the foyer and sign in. If you pre-registered then you can find a printed nametag at the registration table.

Poster presenters should check in to room 2201 now.

Be sure to stick around for the Prize Session at the end of the day; all talk and poster presenters and all volunteers will be awarded prizes at the session.

10:00-11:00 Opening Address *auditorium 2301*

From Robotics to Geometry

Dr. Ruth Charney
Brandeis University

Children build models with 3-dimensional cubes; mathematicians build them with higher dimensional cubes! Many physical systems can be represented by geometric models based on cubes of varying dimensions. Using an example from robotics, we will investigate how such models are constructed and what can we learn from their strange, but beautiful geometry.

11:10-11:25 Parallel Talks Session 1 *(choose one of five talks)*

2202 ***Comparison of Internal Model Validation Methods for Multifactor Dimensionality Reduction***

Jeffrey Gory, North Carolina State University
Holly Sweeney, North Carolina State University

Multifactor Dimensionality Reduction (MDR) is a statistical method used to detect the genes responsible for complex human traits. We simulate genetic data and implement MDR with two different internal model validation procedures (cross-validation and three-way split) to determine which procedure performs better in specified situations.

2203 ***Black-Scholes Option Pricing Model: Analysis, Approximations, and Applications***

Rebecca Presor, University of Mary Washington

In an interdisciplinary field on mathematics and finance, we examined the economic fair price of a stock option using the Black-Scholes equation. After deriving the exact solution to the model, we developed original MATLAB codes and established simulation techniques to display the real option price changes during specific months.

2204 ***Representations of String Links and Tangles***

Christian Bueno, Florida International University

String links are a generalization of the braid group. We study two representations on string links, one inspired by the skein relation of knot theory and another by random walks. We build evidence that these two representations are the same and show a knot theoretic consequence of the conjecture.

2209 ***Public Goods: A Math Game***

Daniel Savelle, St. Mary's College of Maryland

Ever wonder what game theory is? Game theory is mathematics disguised as economics. Come see how the decision to help create a bridge or call the cops can be solved with the help of basic probability and some real analysis.

2210 ***Simplicial Matrix-Tree Theorem and a Polynomial Invariant for Triangulations***

Carlos Bajo, Florida International University
Bradley Burdick, Ohio State University

A classical matrix-tree theorem expresses the cofactors of the Laplacian matrix for a graph as a sum over all spanning trees. This was generalized to simplicial complexes by A. Duval, C. Klivans, and J. Martin using the Laplacian matrix for the corresponding chain complex. Another classical invariant for graphs is the Tutte polynomial.

11:30-11:45 Parallel Talks Session 2 *(choose one of five talks)*

2202 ***Highly Complex Models of Disease Risk***

Erika Alpeter, North Carolina State University
Bethany Vohlers, North Carolina State University

New insights in genetic association mapping recognize human traits as more heavily impacted by higher-order models of disease risk than initially assumed. Using simulations, Multifactor Dimensionality Reduction's (MDR) statistical integrity with high-dimensional models will be evaluated, empirically estimating sample sizes to optimize the model as compared against traditional statistical approaches.

2203 ***Predicting Economic Turning Points***

Pauline Khoo, Hollins University

This study examines Penang, Malaysian's second smallest state with the third largest economy of the country. The focus of the study is to predict the turning point of the economy using the Neftci Probability Method. Using sequential analysis, the economic cycle is predicted to allow decision-making for economic policies.

2204 ***Counting Radius n Hextile Knot Mosaics***

Michael A. Blankenship, Morehead State University

There are 230 radius one hextile knot mosaics. The number of hextile knot mosaics for radius two skyrockets to over 63 trillion. The presentation will focus on the evolution of the algorithms used to count the number of hextile knot mosaics in radius n.

2209 ***Optimizing Plasmonic Effects for a More Efficient Biophotovoltaic Nanodevice***

Jason E. Pina, George Mason University

Plasmonic effects occur when electromagnetic waves cause free electrons to oscillate, allowing the electrons to act as a plasma. In our computational study, we are investigating the use of plasmonic effects to optimize the delivery of light to bacterial photosynthetic reaction centers to increase the efficiency of a biophotovoltaic nanodevice.

2210 ***Permutation Avoidance and the Catalan Triangle***

Wesley Hough, Hanover College

The set containing n-letter permutations that avoid a pattern p is denoted S_n(p). The size of S_n(p) for p of length 3 equals the n-th Catalan number. We improve this result by relating intuitive partitions of S_n(p) to some well-known refinements of the Catalan numbers.

11:50-12:05 Parallel Talks Session 3 *(choose one of five talks/panels)*

2202 ***A Comparison of Different Classification Methods for Breast Cancer prediction***

Hong Thi Thanh Tran, Hollins University

The goal of the project was to develop a mathematical algorithm to determine whether a sample comes from a cancerous patient or not based on gene expression data. Run the SCOOP method and PLSR to seek for significant genes. Then use SVM, PLSR and LDA for classification.

2203 ***Mean-Reverting Pricing Models***

Jody Shipp, George Mason University

We examine changes to a standard pricing model used in finance and economics. We add hysteretic economic agents to an Ornstein-Uhlenbeck process and numerically simulate the system using the Euler-Maruyama method. We then compare the statistics of Ornstein-Uhlenbeck processes with and without hysteresis-type effects.

2204 ***Plotting A-Discriminant Coamoebae in Two Dimensions***

Jeff Sommars, Wheaton College

A recent paper by Nilsson and Passare gave an algorithm for creation of two dimensional coamoebae for A-discriminant polynomials. We will begin by informing the listeners about the definition of coamoebae, and will then discuss some of the unique mathematical challenges of efficiently implementing the algorithm in Sage.

2208 ***Panel Session on Careers and Industry in Mathematics***

Ann Cherry, VCU and Richmond Teacher Residency Program
Brant Jones, James Madison University
Ann Lewis, Rosetta Stone

What can you do with a math degree? What kinds of companies and institutions value mathematical talent? Find out from this panel of people with experience using mathematics outside of academia.

2209 ***Analyzing Projectile Motion with Air Resistance in General Physics Lab***

Joseph Hochstetler, Eastern Mennonite University

When projectile motion is studied in introductory courses, there is a lack of accessible equations that include air resistance to model the flight of the projectile. We propose a model that can be derived using straightforward calculus techniques, then compare our model to experimental data as well as the standard equations without air resistance.

12:10-12:25 Parallel Talks Session 4 *(choose one of six talks/panels)*

2202 ***Tear-film Dehydration of a Soft Contact Lens***

Mihail Sharov, George Mason University

This research explores the factors that cause evaporative dehydration of tear film when a soft contact lens is present. Evaporation of the tear film is affected by various environmental conditions, as well as the length of blink cycles. I plan on developing a realistic model with random cycle durations.

2203 ***Searching for the Implied Market Utility Function***

Aniket Panjwani, George Mason University

Modern portfolio theory (MPT) shows how to choose the optimal portfolio given assets' returns and variances. We introduce a stochastic element to MPT. Then, after making assumptions on agents' behavior, we estimate a 'market utility function'. This function represents the market's preferences over a greater variety of portfolios than MPT.

2204 ***Finding Zero Sets of Tetranomials***

Katherine Turner, Texas A&M University

The real roots of a polynomial can be described combinatorially when its coefficients lie in a large region defined by an A-discriminant amoeba. We examine tetranomials in one variable from this point of view and show how to achieve faster real root counting algorithms.

2208 ***Panel Session on Careers and Industry CONTINUED***

This panel began in the previous session and continues here. Participants may enter or leave during the 12:05-12:25 break as the discussion continues.

2209 ***Mathematical Modeling and Analysis of a Non-linear Large Deformation Plate Model***

James Cameron, George Mason University

We consider the development of a computational model to study stability of large deformation plates that will be applied to wing design for Micro-Air Vehicles. Using a nonlinear Green strain-displacement formulation, a linear constitutive stress-strain formulation, and a Hamiltonian energy approach, we develop the governing differential equations for the displacements.

2210 ***Higher Order Sierpinski numbers***

Wenda Tu, Washington and Lee University
Jean Paul Mugabe, Washington and Lee University

A Sierpinski number is an integer k such that k*2^n + 1 is composite for all natural numbers n. A second order Sierpinski number also has the property that k*2^(2n) + 2^n + 1 is also composite for all n. We will show the existence of higher order Sierpinski numbers.

12:30-2:00 Lunch and Poster Session *2nd floor hallway and foyer*

Lunch: Those who registered for lunches have stars on their nametags and can pick up lunches near registration at 12:30. Poster presenters may pick up their lunches earlier. At 1:00, those who did not reserve a lunch may take a box lunch if any remain. You may eat in any of the talk rooms or side rooms.

Poster Session: Students will be near their posters during lunch.
Stop by and see their excellent work! Poster judging will start at 1:00.

Simplicial Matrix-Tree Theorem and a Polynomial Invariant for Triangulations
Carlos Bajo, Florida International University
Bradley Burdick, Ohio State University

Using Data Clustering Techniques to Predict Movie Preferences
Daniel Bernstein, Davidson College

Representations of String Links and Tangles
Christian Bueno, Florida International University

Profiting with Options Using the Black-Scholes Equation
Kathryn E. Dillinger, University of Mary Washington

Predicting Economic Turning Points
Pauline Khoo, Hollins University

Predictors of Delirium in Hip Fracture Patients
Sandya Lakkur, University of Maryland Baltimore County

Matrices of Continuous Functions
Crystal Peoples, Longwood University

Extension of Grammatical Evolution Decision Trees
Holly Petruso, North Carolina State University
Amanda English, North Carolina State University

Modeling Tree Branching Patterns Using Fractal Geometry
Joy Putney, Governor's School for Science and Technology

A Comparison of Different Classification Methods for Breast Cancer prediction
Hong Thi Thanh Tran, Hollins University

Area Ratios in Eucledian Geometry
Jessica Zlotkowski, Longwood University

AMC Workshop*: From 2:00-3:40 a workshop on preparing for high school AMC mathematics competitions runs concurrently with the SUMS program, in room 2207, for interested high school students, parents, and faculty.*

2:00-2:15 Parallel Talks Session 5 *(choose one of five talks/panels)*

2203 ***Stability of non-linear plate deformations with applications***
Charles Daly, George Mason University
The study of non-linear plate deformations is applicable to many modern day technologies particular micro-air vehicles (MAVs). Understanding the mathematical and computational stability of the coupled partial differential equations governing the complex physical system allows one to design aerodynamic units capable of flight and stability.

2204 ***Symmetric Minimal Surfaces and Harmonic Maps***
Joshua Kaminsky, St Mary's College of Maryland
For many of the classic minimal surfaces, there are well known families with increasing rotational symmetry. Using geometric function theory, we found a transformation that increases the symmetry of a minimal surface. This transformation gives us all of the classical symmetric families, but is also applicable to most surfaces.

2208 ***Panel Session on REUs and Summer Programs***
Wesley Hough, Hanover College
Jeff Sommars, Wheaton College
Nora Stack, St. Mary's College of Maryland
Katherine Turner, Texas A&M University
Thomas Wears, Longwood University
Want to learn more about Research Experience for Undergraduates programs and other summer opportunities in mathematics? Find out from this panel of students.

2209 ***Measuring 3-D Grain Sizes for Crystal Size Distributions Analysis***
Theresa Dalmut, James Madison University
Crystal size distribution (CSD) analysis is used to recover quantitative crystallization information from igneous rocks. We found a new application of singular value decomposition (SVD) for measuring 3-D grain sizes. Computer generated, irregular grain shapes with inscribed ellipsoids were used to determine the closest SVD approximation to the known CSD.

2210 ***An Algebraic Approach to Pebble Motion Problems***
Christian Bueno, Florida International University
Permutation pebble motion problems (PPM) are puzzles in which the central question is whether one arrangement of pebbles on a graph can be turned into another through legal moves. We use group theory to fully answer the question for the case of 1-space, 2-space and 2-connected puzzles.

2:20-2:35 Parallel Talks Session 6 *(choose one of five talks/panels)*

2203 ***Effects of Non-Independent Behavior on a Macroeconomic Model***
Nicholas Chaung, George Mason University

The standard models in use today attempt to calculate macroeconomic variables under the assumption that agents behave independently. However for example, it is well-known that agents behave dependently when predicting inflation. Here, we will investigate the sensitivity of such models to non-independent behavior.

2204 ***Extensions and Applications of Multiplication for Tensors***
Betsy LaRue, James Madison University
Richard Shafer, James Madison University

Tensors (multidimensional arrays) store information for a variety of applications more efficiently and effectively than vectors or matrices. A new, order-preserving tensor multiplication has been developed, which we extended to matrix decompositions, sparse representation, and an image de-blurring application. The resulting algorithms saved space and ran faster than existing routines.

2208 ***Panel Session on REUs and Summer Programs CONTINUED***

This panel began in the previous session and continues here. Participants may enter or leave during the 12:05-12:25 break as the discussion continues.

2209 ***Optimal Harvesting Models for Fishery Populations***
Corinne Wentworth, St. Mary's College of Maryland

Fishery management considers the ecological effects of harvesting. In this talk, we investigate deterministic fishery population models under constant and time-dependent harvesting. Optimization and numerical calculations determined the harvest rate that maximizes yield for various populations. Results show that populations in danger can be fished minimally without causing further harm..

2210 ***Sierpinski and Riesel numbers in N-nacci sequences***
Olivier Mahame, Washington and Lee University

In 2008, Luca and Mejia showed that there are infinitely many Sierpinski numbers and infinitely many Riesel numbers in the sequence of Fibonacci numbers. We demonstrate similar results for the sequences of tribonacci, tetranacci, and pentanacci numbers.

2:40-2:55 Parallel Talks Session 7 *(choose one of five talks/panels)*

2203 ***Modern Portfolio Theory: Assumptions, Accuracy, and Analysis***
Esther Jackson, George Mason University

Through careful selection of assets proportions, Modern Portfolio Theory attempts to maximize portfolio expected return, or equivalently minimize risk, for given levels of the other. We investigate the theory's underlying assumptions and introduce alternative measures and improved techniques from manifold learning theory.

2204 ***Independence Polynomials of Regular Caterpillars***
Michaela Stone, Alfred University

We offer a background of independence polynomials. Specifically, we look at the independence polynomials of regular caterpillars. We will introduce a new closed-form of the standard recursive formula for the independence polynomials of regular caterpillars. We then apply our formula to identify modes of those independence polynomials.

2208 ***Panel Session on Graduate School in Mathematics and Statistics***
Cameron Atkins, Wake Forest University
Melissa Bechard, Wake Forest University
John Johnson, James Madison University
John Monahan, NC State University

What is graduate school really like? How do you apply? What schools should you consider? How important is the GRE subject test? Find out from this panel of actualy graduate students and faculty members from schools with graduate programs.

2209 ***Modeling Mosquitoes***
David MacDonald, James Madison University
Alison Horley, James Madison Universty

We developed stochastic Markov-chain and deterministic ODE simulations of the mosquito life cycle and examined the ability of the simulations to predict growth in Mosquito populations. Concurrently, biological experimentation involving Aedes mosquitoes investigated the interaction between the two species

2210 ***Chomp!***
Nora Stack, St. Mary's College of Maryland

Chomp is a two player, impartial, combinatorial game that can be played in a variety of ways. In addition to the original game, I will discuss some variations on Chomp and original research involving winning strategies for the game.

3:00-3:15 Parallel Talks Session 8 *(choose one of five talks/panels)*

2203 ***Sequential Decision Tree Model for Allocation of Resources***
Sinan Ozdemir, Johns Hopkins University
This paper is dedicated to the problem of finding the optimal defensive allocation of a limited security budget to a finite number of high risk areas in order to minimize the damage done by potential attackers by using a sequential stochastic decision tree that accurately depicts the problem.

2204 ***Linear Recursions and the Laplace transform***
Catherine Rose O'Doherty, University of Mary Washington
We explore various uses of linear recursions, noting their appearance in nature and how linear recursions can be used as a model for different problems. We examine how the Laplace transform can be used to solve linear recursions in a variety of ways.

2208 ***Panel Session on Graduate School CONTINUED***
This panel began in the previous session and continues here. Participants may enter or leave during the 12:05-12:25 break as the discussion continues.

2209 ***An Analytical Approach to Solving Green Oxidation Processes***
Diego Torrejon, George Mason University
Oxidation is a process that often produces hazardous substances; thus, it is imperative to be able to control it in order to make it environmentally safe. We have been able to develop quasi-state approximation that together with perturbation techniques has allowed us to derive an approximate solution matching experimental observations.

2210 ***A Factorial Power Variation of Fermat's Equation***
Matthew J. Green, Towson University
We consider a variant of Fermat's equation x^n+y^n=z^n in which the usual power n is replaced by the factorial power. For n=2 we characterize all integer solutions of the equation and construct an infinite family of non-trivial solutions for n=3. Finally we examine integer solutions for the equation for n>3.

3:15-3:45 Afternoon Tea *2nd floor hallway*

Please join us for tea, coffee, and tasty treats in the HHS foyer. This is your last chance to enter the candy corn contest!

3:45-4:00 Prize Session *auditorium 2301*

After tea please join us in congratulating all of our student presenters and the winners of the poster competition and the candy corn contest.

4:00-5:00 Closing Address *auditorium 2301*

Blown Away:
What Knot to Do When Sailing

Sir Randolph Bacon III, cousin-in-law to
Dr. Colin Adams
Williams College

Being a tale of adventure on the high seas involving great risk to the tale teller, and how an understanding of the mathematical theory of knots saved his bacon. No nautical or mathematical background assumed.